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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/892,332	06/26/2001	Ching-Wei Chang	TAL/7146.119	1906

7590 08/22/2005

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EXAMINER	
THOMPSON, JAMES A	
ART UNIT	**PAPER NUMBER**
2624	

DATE MAILED: 08/22/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/892,332	CHANG, CHING-WEI	
	Examiner	Art Unit	
	James A. Thompson	2624	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 02 June 2005.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☐ Claim(s) _____ is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-22 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 26 June 2001 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date 6/2/05.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

1. Applicant's arguments, see page 7, lines 3-16, filed 02 June 2005, with respect to the rejections of claims 1-4 and claims 12-19 under 35 USC §112, 2nd paragraph have been fully considered and are persuasive. The rejections of claims 1-4 and claims 12-19 under 35 USC §112, 2nd paragraph listed in items 2-4 of the previous office action, dated 04 January 2005, have been withdrawn.

2. Applicant's arguments filed 02 June 2005 have been fully considered but they are not persuasive.

Firstly, as discussed on the last four lines of page 4 to page 5, line 3, Examiner has shown that the value $D/2$ is the error threshold. Examiner has not suggested (as Applicant states on page 8, lines 9-10 of Applicant's present arguments) that the average grey level value is the error value. A threshold value is determined. The difference between the pixel value and the value of the variable T is the error value. In this case, if the error is greater than $D/2$, then either a first threshold ($T+D/2$) or a second threshold ($T-D/2$) is selected (see the last 9 lines of page 4 of said previous office action). If the error is less than $D/2$, an alternate (third) threshold is selected based on different criteria (see the last 2 lines of page 4 to page 5, line 3 of said previous office action). The error may also be considered to be the difference between the grey level value of the pixel and the resultant black or white output, as is standard in the halftoning arts, since the value

of the variable T is directly related to the upper (255 for 8-bit halftoning) and lower (0 for any-bit halftoning) pixel values corresponding to a result of black or white.

However, Examiner does agree with Applicant's statement on page 8, lines 13-15 of Applicant's present arguments that Zlotnick (US Patent 6,351,566 B1) does not teach that said error is "accumulated error".

Examiner disagrees, however, with Applicant's parenthetical statement on page 8, lines 15-18 of Applicant's present arguments that Zlotnick teaches that pixels are binarized based solely on the threshold value T. The pixels are binarized based on $T+D/2$ in one case since, if the pixel value is below $T+D/2$, said resultant pixel will not be rendered white (see figure 5(54) of Zlotnick). Further, if a pixel value is above $T-D/2$, then said resultant pixel will not be rendered black (see figure 5(54) of Zlotnick). Thus, $T+D/2$ and $T-D/2$ are properly considered to be two separate and distinct threshold values according to the meaning generally accepted in the halftone printing arts. Furthermore, Zlotnick specifically refers the values $T+D/2$ and $T-D/2$ as the "upper threshold" and "lower threshold", respectively (column 8, lines 5-6 of Zlotnick).

The amendments to the claims have necessitated the new grounds of rejection that are given below in the prior art rejections.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 1-11 and 20-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zlotnick (US Patent 6,351,566 B1) in view of Ostromoukhov (US Patent 6,356,362 B1).

Regarding claim 1: Zlotnick discloses selecting a first intensity threshold if an error of at least one of a current pixel and a neighboring pixel exceeds a first error threshold (figure 5(54) and column 8, lines 5-13 of Zlotnick). The error threshold is $D/2$ (column 8, lines 5-6 of Zlotnick). If the error of the current pixel is greater than $D/2$, then the threshold T is used, since a black or white pixel is therefore determined based upon the relationship of said current pixel value to said threshold if said error is greater than $D/2$ (column 8, lines 6-13 of Zlotnick).

Zlotnick further discloses selecting a second intensity threshold (figure 6(56); column 8, lines 12-13; and column 9, lines 36-41 of Zlotnick) based on neighborhood values if said first intensity threshold if not selected (column 9, lines 41-49 of Zlotnick).

Zlotnick does not disclose expressly that said error is an accumulated error; selecting a second intensity threshold if an error of a pixel *remotely* neighboring said current pixel exceeds a second error threshold and said first intensity threshold if not selected; and selecting a third intensity threshold if neither of said first and said second intensity threshold are selected.

Ostromoukhov discloses that the error for each of the pixels is accumulated error (column 9, lines 42-49 of Ostromoukhov); selecting a second intensity threshold (figure 8 (S804) of Ostromoukhov) if a gradient of a pixel remotely neighboring said current pixel exceeds a second threshold; and selecting a third intensity threshold (figure 8(S805) of Ostromoukhov) if said second intensity threshold is not selected (figure 8(S803-S805) and column 10, lines 30-38 of Ostromoukhov).

Zlotnick and Ostromoukhov are combinable because they are from the same field of endeavor, namely digital image data halftoning and binarization. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to include an additional (second) threshold selection as taught by Ostromoukhov wherein said second threshold is selected based on neighboring pixel data. The gradient in said neighborhood is also directly related to the amount of error based on a fixed threshold for the pixels in the neighborhood. If there is a larger gradient, there is a larger variation from the threshold in the neighboring pixels, and thus a larger error for at least some of the neighboring pixels. Further, instead of basing said threshold selection on gradient, as taught by Ostromoukhov, said threshold selection can simply be based on the error amount, as taught by Zlotnick, wherein the error amount is the accumulated error, as taught by Ostromoukhov. Thus, instead of simply comparing the pixel value to the threshold values $T+D/2$ and $T-D/2$, the pixel value plus the error value would be compared to $T+D/2$ and $T-D/2$. Further, it would have been obvious to a person of ordinary skill in the art at the time of the invention to include a default (third) intensity threshold as taught by

Ostromoukhov. Since said third threshold is a default threshold, then said threshold would be selected if said first threshold taught by Zlotnick and said second threshold taught by Ostromoukhov are not selected. The motivation for doing so would have been that the characteristics of the neighboring pixels affect the level of noise and artifacts that occur in halftoning (column 9, lines 13-19 of Ostromoukhov). Therefore, it would have been obvious to combine Ostromoukhov with Zlotnick to obtain the invention as specified in claim 1.

Regarding claim 2: Zlotnick discloses that said first error threshold ($D/2$) is optimized (column 8, lines 62-64 of Zlotnick) in order to preserve true edges in the binary image (column 9, lines 4-6 of Zlotnick). Therefore, since a true edge has very small variations in pixel values, the variation from the threshold value for determining a true edge is very small. Thus, said first error threshold ($D/2$) must be substantially zero error in order to determine if there is a true edge.

Regarding claim 3: Zlotnick discloses that said first intensity threshold (T) is used to determine a true edge of the binary image (column 9, lines 4-6 of Zlotnick) and said second intensity threshold (figure 6("Average") of Zlotnick) is used for the intermediate value pixels (column 9, lines 41-49 of Zlotnick). Therefore, an intensity of said first intensity threshold is greater than an intensity of said second intensity threshold.

Zlotnick does not disclose expressly that said intensity of said second intensity threshold is greater than an intensity of said third intensity threshold.

Ostromoukhov discloses that said third intensity threshold (figure 8(S805) of Ostromoukhov) is selected if a gradient is

not sufficiently high to select a second intensity threshold (figure 8(S804) of Ostromoukhov) (column 10, lines 30-38 of Ostromoukhov).

Zlotnick and Ostromoukhov are combinable because they are from the same field of endeavor, namely digital image data halftoning and binarization. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to set said third intensity threshold taught by Ostromoukhov to a lower value that said second intensity threshold since the gradient is even smaller than for said second intensity threshold. In Zlotnick, said second intensity threshold is set to a smaller value than said first intensity threshold since the pixel error shows that the current pixel is not part of a true edge (column 9, lines 4-6 and lines 39-44 of Zlotnick). The neighborhood of a true edge clearly has a higher gradient than an area that does not have a true edge, since the value around an edge changes rapidly. Therefore, since said third intensity threshold taught by Ostromoukhov has a smaller gradient than said second intensity threshold taught by Ostromoukhov (column 10, lines 30-38 of Ostromoukhov), the intensity of said third intensity threshold is less than the intensity of said second intensity threshold. The suggestion for doing so would have been that the gradient of said third intensity threshold is smaller than the gradient of said second intensity threshold (column 10, lines 30-38 of Ostromoukhov). Therefore, it would have been obvious to combine Ostromoukhov with Zlotnick to obtain the invention as specified in claim 3.

Further regarding claim 4: Ostromoukhov discloses that at least one of said accumulated error of said first pixel, said neighboring pixel, and said remote neighboring pixel comprises a

component color error for said pixel (column 6, lines 20-24 of Ostromoukhov). Since the image data that is processed is color image data (column 6, lines 20-24 of Ostromoukhov), said accumulated pixel error is therefore component color error for each pixel.

Regarding claim 5: Zlotnick discloses determining an intensity of a current pixel in an image (figure 5(50) and column 7, line 66 to column 8, line 3 of Zlotnick); and selecting a first intensity threshold if at least one of said current pixel error and a neighboring pixel error is less than an error threshold (figure 5(54) and column 8, lines 5-13 of Zlotnick) and otherwise selecting a second intensity threshold (figure 6(56); column 8, lines 12-13; and column 9, lines 36-41 of Zlotnick). The error threshold is $D/2$ (column 8, lines 5-6 of Zlotnick). If the error of the current pixel is greater than $D/2$, then the threshold T is used, since a black or white pixel is therefore determined based upon the relationship of said current pixel value to said threshold if said error is greater than $D/2$ (column 8, lines 6-13 of Zlotnick). If not, a threshold based on the neighborhood pixel values is selected (column 8, lines 12-13; and column 9, lines 36-41 of Zlotnick).

Zlotnick further discloses displaying said current pixel with one of a first displayed intensity if the intensity of said current pixel exceeds said selected intensity threshold (figure 5("WHITE") and figure 6("WHITE") of Zlotnick) and otherwise displaying said current pixel with a second displayed intensity (figure 5("BLACK") and figure 6("BLACK") of Zlotnick) (column 8, lines 8-11 and column 9, lines 38-41 of Zlotnick).

Zlotnick does not disclose expressly that said error is an accumulated error; augmenting said intensity of said current

pixel with a current said accumulated pixel error; and assigning said accumulated error between said displayed intensity and said augmented intensity of said current pixel to at least one pixel neighboring said current pixel.

Ostromoukhov discloses that the error for each of the pixels is accumulated error (column 9, lines 42-49 of Ostromoukhov); augmenting said intensity of said current pixel with a current said accumulated pixel error; and assigning said accumulated error between said displayed intensity and said augmented intensity of said current pixel to at least one pixel neighboring said current pixel (figure 8(S810-S812) and column 10, lines 47-56 of Ostromoukhov). Error diffusion is part of an iterative process that occurs for each pixel (figure 8 of Ostromoukhov). Therefore error diffusion will occur to the current pixel via the error calculations and diffusions of neighboring pixels, and the resultant error after binarization of said current pixel will be distributed to other neighboring pixels (column 10, lines 47-56 of Ostromoukhov).

Zlotnick and Ostromoukhov are combinable because they are from the same field of endeavor, namely digital image data halftoning and binarization. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to perform error diffusion using accumulated pixel error, as taught by Ostromoukhov, and thus augment the intensity of said current pixel with a current accumulated error and assign said accumulated error between the displayed value and the augmented value of said current pixel to at least one neighboring pixel. The motivation for doing so would have been that error diffusion enhances image sharpness, preserves fine image detail, and yields an overall pleasing image (column 1, lines 41-44 of

Ostromoukhov). Therefore, it would have been obvious to combine Ostromoukhov with Zlotnick to obtain the invention as specified in claim 5.

Regarding claim 6: Zlotnick discloses that said error threshold ($D/2$) is optimized (column 8, lines 62-64 of Zlotnick) in order to preserve true edges in the binary image (column 9, lines 4-6 of Zlotnick). Therefore, since a true edge has very small variations in pixel values, the variation from the threshold value for determining a true edge is very small. Thus, said error threshold ($D/2$) must be substantially zero error in order to determine if there is a true edge.

Regarding claim 7: Zlotnick discloses that said first displayed intensity comprises a maximum intensity (column 8, lines 10-11 and column 9, lines 47-49 of Zlotnick) and said second displayed intensity comprises a minimum intensity (column 8, lines 8-10 and column 9, lines 44-46 of Zlotnick). As is well-known in the art, white (binary 0) is the maximum intensity and black (binary 1) is the minimum intensity.

Further regarding claim 8: Ostromoukhov discloses that said intensity of said current pixel comprises an intensity of a color component of said pixel (column 6, lines 20-24 of Ostromoukhov).

Regarding claim 9: Zlotnick discloses that said first intensity threshold (T) is used to determine a true edge of the binary image (column 9, lines 4-6 of Zlotnick) and said second intensity threshold (figure 6("Average") of Zlotnick) is used for the intermediate value pixels (column 9, lines 41-49 of Zlotnick). Therefore, an intensity of said first intensity threshold is greater than an intensity of said second intensity threshold.

Regarding claim 10: Zlotnick discloses displaying said current pixel with said first displayed intensity if said augmented intensity of said current pixel exceeds a third intensity threshold ($T+D/2$) (figure 5(54) and column 8, lines 5-11 of Zlotnick), an intensity of said third intensity threshold being greater than an intensity of said first intensity threshold ($T+D/2>T$).

Further regarding claim 11: Ostromoukhov discloses that at least one of said current accumulated pixel error and said neighboring accumulated pixel error comprises a component color error (column 6, lines 20-24 of Ostromoukhov). Since the image data that is processed is color image data (column 6, lines 20-24 of Ostromoukhov), said pixel error is therefore component color error for each pixel.

Regarding claim 20: Zlotnick discloses a halftoning encoder (figure 4 of Zlotnick) comprising a selected thresholding unit (figure 4(44(portion)) of Zlotnick) comparing an input intensity of a current pixel to a selected threshold intensity (column 8, lines 5-13 and column 9, lines 44-49 of Zlotnick); and a threshold selection unit (figure 4(44 (portion)) of Zlotnick) selecting one of a plurality of threshold intensities for said selected threshold unit in response to an error for at least one of said current pixel and a pixel neighboring said current pixel (column 8, lines 5-13 and column 9, lines 39-49 of Zlotnick). If the error of the current pixel is greater than $D/2$, said current pixel is determined to be either white or black (column 8, lines 5-11 of Zlotnick). If the error of the current pixel is less than $D/2$, said current pixel is marked as an intermediate pixel (column 8, lines 12-13

and column 9, lines 39-44 of Zlotnick) and then compared with an alternate threshold (column 9, lines 41-49 of Zlotnick). The processor (figure 4(44) of Zlotnick) performs the image processing operations of said halftoning encoder (column 7, lines 43-47 of Zlotnick). Said selected thresholding unit and said threshold selection unit are the portions of said processor, along with the corresponding embodied software (column 7, lines 53-58 of Zlotnick), that perform the functions of said selected thresholding unit and said threshold selection unit.

Zlotnick does not disclose expressly that said error is an accumulated error.

Ostromoukhov discloses that the error for each of the pixels is accumulated error (column 9, lines 42-49 of Ostromoukhov).

Zlotnick and Ostromoukhov are combinable because they are from the same field of endeavor, namely digital image data halftoning and binarization. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use for the error amount taught by Zlotnick an accumulated error, as taught by Ostromoukhov. Thus, instead of simply comparing the pixel value to the threshold values $T+D/2$ and $T-D/2$, the pixel value plus the error value would be compared to $T+D/2$ and $T-D/2$. The motivation for doing so would have been that error diffusion enhances image sharpness, preserves fine image detail, and yields an overall pleasing image (column 1, lines 41-44 of Ostromoukhov). Therefore, it would have been obvious to combine Ostromoukhov with Zlotnick to obtain the invention as specified in claim 20.

Regarding claim 21: Zlotnick discloses an initial thresholding unit (figure 4(44(portion)) of Zlotnick) comparing said input intensity of said current pixel to an initial threshold intensity (T+D/2) (figure 5(54) and column 8, lines 5-11 of Zlotnick). Since D is clearly a positive number (column 8, lines 5-11 of Zlotnick), said initial threshold intensity (T+D/2) is greater than one of the possible selected intensity thresholds (T). Since the other possibly selected intensity threshold (figure 6("AVERAGE") of Zlotnick) is for use with intermediate values (column 8, lines 8-14 of Zlotnick), said other intensity threshold is less than (T). Therefore, said initial intensity threshold is greater than said selected threshold intensity.

Regarding claim 22: Zlotnick does not disclose expressly an error filter distributing an error produced by printing said current pixel to a plurality of pixels neighboring said current pixel; and an error buffer accumulating said distributed error for a pixel.

Ostromoukhov discloses an error filter (figure 7(110) of Ostromoukhov) distributing an error produced by printing said current pixel to a plurality of pixels neighboring said current pixel (column 9, lines 50-54 of Ostromoukhov). Since said error diffusion is performed for each pixel address (column 9, lines 53-56 of Ostromoukhov) and the RAM (figure 5(51) of Ostromoukhov) is the working memory of the image processing software (column 5, lines 33-35 of Ostromoukhov), an error buffer (figure 5(51(portion)) of Ostromoukhov) accumulating said distributed error for a pixel is part of the overall RAM.

Zlotnick and Ostromoukhov are combinable because they are from the same field of endeavor, namely digital image data

halftoning and binarization. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to perform error diffusion with said error filter and said error buffer taught by Ostromoukhov. The motivation for doing so would have been that error diffusion enhances image sharpness, preserves fine image detail, and yields an overall pleasing image (column 1, lines 41-44 of Ostromoukhov). Therefore, it would have been obvious to combine Ostromoukhov with Zlotnick to obtain the invention as specified in claim 22.

5. Claims 12-15 and 17-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zlotnick (US Patent 6,351,566 B1) in view of Ostromoukhov (US Patent 6,356,362 B1) and Shu (US Patent 5,757,976).

Regarding claim 12: Zlotnick discloses determining an intensity of a current pixel in an image (figure 5(50) and column 7, line 66 to column 8, line 3 of Zlotnick); and selecting a first intensity threshold (figure 6(60) of Zlotnick) if at least one of a current pixel error and an immediate neighboring pixel error is less than a first error threshold (figure 5(54) and column 8, lines 5-13 of Zlotnick). The first error threshold is $D/2$ (column 8, lines 5-6 of Zlotnick). If the error of the current pixel is less than $D/2$ (column 8, lines 6-13 of Zlotnick), then a threshold based on the neighborhood pixel values is used (column 8, lines 12-13; and column 9, lines 36-41 of Zlotnick).

Zlotnick further discloses displaying said current pixel with one of a first displayed intensity if the intensity of said current pixel exceeds said selected intensity threshold (figure 5("WHITE") and figure 6("WHITE") of Zlotnick) and otherwise

displaying said current pixel with a second displayed intensity (figure 5("BLACK") and figure 6("BLACK") of Zlotnick) (column 8, lines 8-11 and column 9, lines 38-41 of Zlotnick).

Zlotnick does not disclose expressly that said error is an accumulated error; augmenting said intensity of said current pixel with a current pixel error; selecting a second intensity threshold if a remote neighboring pixel error is less than a second error threshold and said first error threshold is not selected; selecting a third intensity threshold if a more remote neighboring pixel error is less than a third error threshold and one of said first and said second error thresholds is not selected; selecting a fourth intensity threshold if one of said first, said second, and said third intensity thresholds is not selected; and assigning an error between said displayed intensity and said augmented intensity of said current pixel to at least one pixel neighboring said current pixel.

Ostromoukhov discloses that the error for each of the pixels is accumulated error (column 9, lines 42-49 of Ostromoukhov); augmenting said intensity of said current pixel with a current pixel accumulated error; and assigning an accumulated error between said displayed intensity and said augmented intensity of said current pixel to at least one pixel neighboring said current pixel (figure 8(S810-S812) and column 10, lines 47-56 of Ostromoukhov). Error diffusion is part of an iterative process that occurs for each pixel (figure 8 of Ostromoukhov). Therefore error diffusion will occur to the current pixel via the error calculations and diffusions of neighboring pixels, and the resultant error after binarization of said current pixel will be distributed to other neighboring pixels (column 10, lines 47-56 of Ostromoukhov).

Ostromoukhov further discloses selecting a second intensity threshold (figure 8(S805) of Ostromoukhov) if a gradient of a pixel remotely neighboring said current pixel is less than a second threshold (figure 8(S803-S805) and column 10, lines 30-36 of Ostromoukhov); selecting a third intensity threshold (figure 8(S805) of Ostromoukhov) if a remote neighboring pixel gradient (column 8, lines 37-40 of Ostromoukhov) is less than a third threshold (figure 8(S803-S805) and column 10, lines 30-36 of Ostromoukhov); and selecting a fourth intensity threshold (figure 8(S804) of Ostromoukhov) if said second intensity threshold and said third intensity threshold is not selected (figure 8(S803-S805) and column 10, lines 35-38 of Ostromoukhov). If the gradient of the neighborhood is less than a threshold value, then one of a plurality of different possible threshold masks is selected (column 10, lines 31-36 of Ostromoukhov). Since the gradient is based on the neighborhood pixel values (column 10, lines 31-32 of Ostromoukhov) and the calculation of a gradient is based on the gradients of all the pixels in said neighborhood, said second intensity threshold is based on the gradient of a pixel remotely neighboring said current pixel and said third intensity threshold is based on the gradient of a more remote neighboring pixel.

Zlotnick and Ostromoukhov are combinable because they are from the same field of endeavor, namely digital image data halftoning and binarization. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to perform error diffusion, as taught by Ostromoukhov, and thus augment the intensity of said current pixel with a current accumulated error and assign an accumulated error between the displayed value and the augmented value of said current pixel to

at least one neighboring pixel. The motivation for doing so would have been that error diffusion enhances image sharpness, preserves fine image detail, and yields an overall pleasing image (column 1, lines 41-44 of Ostromoukhov). Further, it would have been obvious to a person of ordinary skill in the art at the time of the invention to include additional (second and third) intensity threshold selections, as taught by Ostromoukhov, wherein the second intensity threshold and third intensity threshold are selected based on remote neighboring pixel data. The gradient of said remotely neighboring pixels is also directly related to the amount of accumulated error based on a fixed threshold for the pixels in the neighborhood. If there is a smaller gradient, there is a smaller variation from the threshold in the neighboring pixels, and thus a smaller accumulated error for at least some of the remotely neighboring pixels. Further, instead of basing said threshold selection on gradient, as taught by Ostromoukhov, said threshold selection can simply be based on the accumulated error amount, as taught by Zlotnick. Further, it would have been obvious to a person of ordinary skill in the art at the time of the invention to include a default (fourth) intensity threshold as taught by Ostromoukhov. Since said fourth threshold is a default threshold, then said threshold would be selected if said first threshold taught by Zlotnick and said second and said third thresholds taught by Ostromoukhov are not selected. The motivation for doing so would have been that the characteristics of the neighboring pixels affect the level of noise and artifacts that occur in halftoning (column 9, lines 13-19 of Ostromoukhov). Therefore, it would have been obvious to combine Ostromoukhov with Zlotnick.

Zlotnick in view of Ostromoukhov does not disclose expressly selecting said third intensity threshold based on a more remote neighboring pixel accumulated error if said second error threshold is not selected.

Shu discloses selecting between a first intensity threshold (figure 9(930A) of Shu) and a second intensity threshold (figure 9(930B) of Shu) based on pixel accumulated error (column 12, lines 5-12 of Shu). By modifying the error filter, the difference between the threshold and the pixel value is modified. Modifying the error filter is the same as modifying the thresholds since the relative difference between the pixel and threshold is the criteria by which the determination is made to turn a pixel on or off.

Zlotnick in view of Ostromoukhov is combinable with Shu because they are from the same field of endeavor, namely digital image data halftoning and binarization. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to specifically select between two possible intensity thresholds, as taught by Shu, a first intensity threshold based on remotely neighboring pixel accumulated error and a second intensity threshold based on a more remotely neighboring pixel accumulated error, as taught by Ostromoukhov, said first intensity threshold taught by Shu corresponding to the second intensity threshold taught by Ostromoukhov and said second intensity threshold taught by Shu corresponding to the third intensity threshold taught by Ostromoukhov. The motivation for doing so would have been to minimize printing artifacts (column 3, lines 54-57 of Shu). Therefore, it would have been obvious to combine Shu with Zlotnick in view of Ostromoukhov to obtain the invention as specified in claim 12.

Regarding claim 13: Zlotnick discloses that said first error threshold ($D/2$) is optimized (column 8, lines 62-64 of Zlotnick) in order to preserve true edges in the binary image (column 9, lines 4-6 of Zlotnick). Therefore, since a true edge has very small variations in pixel values, the variation from the threshold value for determining a true edge is very small. Thus, said first error threshold ($D/2$) must be substantially zero error in order to determine if there is a true edge.

Regarding claim 14: Zlotnick discloses that said first displayed intensity comprises a maximum intensity (column 8, lines 10-11 and column 9, lines 47-49 of Zlotnick) and said second displayed intensity comprises a minimum intensity for said pixel (column 8, lines 8-10 and column 9, lines 44-46 of Zlotnick). As is well-known in the art, white (binary 0) is the maximum intensity and black (binary 1) is the minimum intensity.

Further regarding claim 15: Ostromoukhov discloses that said intensity of said current pixel comprises an intensity of a color component of said pixel (column 6, lines 20-24 of Ostromoukhov).

Regarding claim 17: Zlotnick discloses displaying said current pixel with a maximum displayed intensity if said augmented intensity of said current pixel exceeds a fifth intensity threshold ($T+D/2$) (figure 5(54) and column 8, lines 5-11 of Zlotnick), an intensity of said fifth intensity threshold being greater than an intensity of said first intensity threshold ($T+D/2>T$).

Further regarding claim 18: Ostromoukhov discloses that at least one of said current pixel accumulated error, said neighboring pixel accumulated error, and said remote neighboring

pixel accumulated error comprises a component color error for said pixel (column 6, lines 20-24 of Ostromoukhov). Since the image data that is processed is color image data (column 6, lines 20-24 of Ostromoukhov), said pixel error is therefore component color error for each pixel.

6. Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Zlotnick (US Patent 6,351,566 B1) in view of Ostromoukhov (US Patent 6,356,362 B1), Shu (US Patent 5,757,976), and obvious engineering design choice.

Regarding claim 16: Zlotnick discloses that said first intensity threshold (T) is used to determine a true edge of the binary image (column 9, lines 4-6 of Zlotnick) and said second intensity threshold (figure 6("Average") of Zlotnick) is used for the intermediate value pixels (column 9, lines 41-49 of Zlotnick). Therefore, an intensity of said first intensity threshold is greater than an intensity of said second intensity threshold.

Zlotnick does not disclose expressly that said intensity of said second intensity threshold is greater than an intensity of said third intensity threshold, and said intensity of said third intensity threshold is greater than an intensity of said fourth intensity threshold.

Ostromoukhov discloses said third intensity threshold (figure 8(S805) of Ostromoukhov) and said fourth intensity threshold (figure 8(S804) of Ostromoukhov) (column 10, lines 30-38 of Ostromoukhov).

Zlotnick and Ostromoukhov are combinable because they are from the same field of endeavor, namely digital image data halftoning and binarization. At the time of the invention, it

would have been obvious to a person of ordinary skill in the art to include said third intensity threshold and said fourth intensity threshold taught by Ostromoukhov. The motivation for doing so would have been to have more threshold values to choose from based on the image characteristics (column 10, lines 33-36 of Ostromoukhov). Therefore, it would have been obvious to combine Ostromoukhov with Zlotnick.

It would have been an obvious engineering design choice to set said third intensity threshold taught by Ostromoukhov to a lower intensity value that said second intensity threshold taught by Zlotnick and set said fourth intensity threshold taught by Ostromoukhov to a lower intensity value than said third intensity threshold. In Zlotnick, said second intensity threshold is set to a smaller value than said first intensity threshold since the pixel error shows that the current pixel is not part of a true edge (column 9, lines 4-6 and lines 39-44 of Zlotnick). The suggestion for doing so would have been that the intensity of said first intensity threshold is greater than the intensity of said second intensity threshold, as taught by Zlotnick. Setting the intensities of said third and said fourth intensity thresholds such that the intensity of said intensity threshold is greater than an intensity of said third intensity threshold, and said intensity of said third intensity threshold is greater than an intensity of said fourth intensity threshold simply continues the pattern of intensity threshold values.

7. Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Zlotnick (US Patent 6,351,566 B1) in view of Ostromoukhov (US Patent 6,356,362 B1), Shu (US Patent 5,757,976), and Harrington (US Patent 6,072,591).

Regarding claim 19: Zlotnick in view of Ostromoukhov and Shu does not disclose expressly that said component color error comprises an error for a component color other than the component color of the current pixel.

Harrington discloses an error for a component color other than the component color of the current pixel (column 5, lines 27-30 and lines 50-57 of Harrington). By computing sums (column 5, lines 27-30 of Harrington) and differences (column 5, lines 50-57 of Harrington) of the primary color components (CMY), the error is determined for color components that not the component color of said current pixel (column 5, lines 27-30 and lines 50-57 of Harrington).

Zlotnick in view of Ostromoukhov and Shu is combinable with Harrington because they are from the same field of endeavor, namely digital image halftoning. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use the sum and difference components taught by Harrington for error diffusion. The motivation for doing so would have been that using said sum and difference components simplifies the vector error diffusion calculations (column 2, lines 61-64 of Harrington). Therefore, it would have been obvious to combine Harrington with Zlotnick in view of Ostromoukhov and Shu to obtain the invention as specified in claim 19.

Conclusion

8. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to James A. Thompson whose telephone number is 571-272-7441. The examiner can normally be reached on 8:30AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David K. Moore can be reached on 571-272-7437. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

James A. Thompson
Examiner
Art Unit 2624

JAT
11 August 2005

THOMAS D
~~TOMMY~~ LEE
PRIMARY EXAMINER